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ABSTRACT

This document provides science curriculum instructional material relating to marine biology. Items presented relate to live animal exhibits seen during visits to Sea World marine aquarium exhibits; however, all materials are also useful for in-class instruction without visits to Sea World displays. Ideally, material should be reviewed immediately prior to a Sea World exhibit. This unit has a theme of behavior and includes transparencies and information sheets on bottlenose dolphins, the walrus, harbor seals, innate behavior, learned behavior, and trained behavior. (SL)

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SEA WORLD Curriculum Guide

Program Theme: BEHAVIOR 4-8

A SEA WORLD EDUCATIONAL PUBLICATION
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SE 022 546

BOTTLENOSE DOLPHIN FACT SHEET

SEA WORLD EDUCATION DEPARTMENT

1975

BOTTLENOSE DOLPHIN FACT SHEET

I. Scientific name--*Tursiops truncatus*

A. Bottlenose dolphins belong to the scientific order *Cetacea*, which includes all whales. This large order is further divided into three suborders: the toothed whales, *Odontocetti*, including killer whales, belugas, dolphins and porpoises; the baleen whales, *Mystecetti*, blue whales, gray whales, etc., and the extinct *Archaeoceti*.
B. Bottlenose dolphins belong to the family *Delphinidae*
C. There are two subspecies of bottlenose dolphins
Atlantic bottlenose, *Tursiops truncatus* (Montagu)
Pacific bottlenose, *Tursiops gilli*
D. Dolphins (mammals) are often confused with the dolphin fish, served in restaurants as "mahi mahi", *Coryphaena hippurus*

II. Distribution

A. Primarily an inshore, coastal mammal, the bottlenose dolphin inhabits temperate to tropical waters, often coming into shallow inlets, bays and lagoons.
B. The Atlantic bottlenose is found along both Atlantic coasts, being the most common dolphin species along the United States from Cape Cod through the Gulf of Mexico. It also is found along European shores and in the Mediterranean.
C. The Pacific bottlenose inhabits the waters off southern California and occurs as far south as Central America, including the Gulf of California.

III. Size

A. The Atlantic bottlenose is somewhat smaller in size than the Pacific, although in European waters they do grow to an equivalent size.
1. Pacific bottlenose: 10-12 feet (3-3.6 metres); 500-1000 lbs (220-455 kg) are very thick in the mid region.
2. Atlantic bottlenose: 7-10 feet (2-3 metres); 300-500 lbs (136-455 kg) in the Mediterranean, they grow to 12 feet (3.6 m) or more.
B. Female dolphins grow to be the same size as males or just slightly smaller. (Many toothed whales characteristically exhibit a type of sexual dimorphism in which males outmeasure the females. This is just opposite in baleen whales where the females are measurably larger than the males.)
C. Young at birth are 28-30 inches (.71-.76 m) 30 lbs (13.6 kg)

IV. Description

A. Sleek torpedo-shaped bodies, padded by a layer of blubber for streamlining and insulation. Have elongated snouts which account for their name, bottlenose.

B. Generally are varying shades of gray, with light and dark markings. Their bellies, lower jaw and anal regions are white.

C. Pacific form is generally darker than the Atlantic form. Some Pacific bottlenose, found in the Gulf of California and Central America, are almost black. This color difference is thought by some scientists to be an evolutionary response to the stronger tropical sun in the Pacific. That is to say that the color change is a tanning of the skin to compensate for the stronger sunlight the animal receives.

D. Older females sometimes develop an inconspicuous spotting along the sides and on the belly. These animals show evidence in ovaries of having borne young, so that the spotting is thought by some to be a secondary sex characteristic.

E. The young are normally much darker than the adults. Often they have several vertical light colored bars that mark the middle of their bodies, near the dorsal fin. These are thought to be the result of fetal folding while the animal is slightly curled in the mother's womb.

V. Swimming adaptation; It is believed that, like all marine mammals the ancestors of the dolphin once lived on land, but returned to the sea 45 million years ago. During the course of their evolution, several adaptations developed that enabled them to successfully live in their marine environment. These changes include the following:

A. Pectoral flippers: The front flippers (more pointed than those of the killer whale) are comparable in bone structure to the forelimbs of terrestrial mammals except that they are shortened and compact and rigidly supported by thick cartilage pads between the bones. (Used for steering and stopping.)

B. Dorsal fin: Sickle-shaped fin in the middle of the dolphin's back. For this species it acts like a keel in adding stability to the dolphin as it swims. Each side of the tail (or lobe) is called a fluke, and swimming is done with an up and down motion of the tail flukes. The total spread of the tail is about one ninth of the body length.

D. Hind limbs: All traces of hind limbs have disappeared in the dolphin except for a few tiny, vestigial bones of the pelvic girdle.

VI. Swimming and diving ability

A. Swimming

1. Bottlenose dolphins can swim at speeds of up to 18-22 mph but they usually cruise at a much slower speed, between 5-7 mph. (This species is slower than some of the other faster swimming pelagic species such as the Dall's porpoise.)

2. In the open water, dolphins swim in close-knit, precise ranks which form a kind of pyramid in the water. A hierarchy exists in the swimming order with the more

dominant animals and the strongest swimmers at the top of the water.

3. Frequently bottlenose dolphins are seen riding the bow waves of ships or playing in the surf off the coastline.
4. Dolphin will breach, jumping sometimes 15-20 feet out of the water.

B. Diving

1. Bottlenose dolphins generally do not neet to dive very deeply as they inhabit shallow coastal waters and dive only to catch their food (fish which live in shallow waters).
2. Bottlenose are capable of diving to great depths. The Atlantic have been observed at over 300 feet and been heard at over 600 feet. However, their main food fish (inferred from their diet) indicates they regularly dive to 650 feet for the fish. One dolphin named Tuffy was trained by the Navy to dive to 990 feet.
3. Pacific bottlenose have been observed at depths of 167 feet.
4. The bottlenose can hold its breath for about 7 min. in a deep dive.
5. While diving, the bottlenose, like all marine mammals, has special physiological functions during the dive. While underwater the blood supply is shunted away from tissues tolerant of low oxygen levels to the heart and central nervous system. The muscle has a high myoglobin level (oxygen carriers) to help prevent tetany, or muscle oxygen deficiency.

VII. Feeding habits

A. Probably eat between 15-20 lbs. of fish a day, on the average. Although they do gorge themselves when food is available, they sometimes go for long periods without eating.

B. Bottlenose dolphins eat primarily fish but sometimes eat small amounts of shrimp and squid and crustaceans.

C. Usually they swallow fish whole, head first, so the spines of the fish won't catch in their throats. On larger fish, they break the heads by shaking them and/or, in shallow seas, rubbing them on the ocean floor.

D. Teeth

1. They are sharp, conical and interlock so the teeth point backwards, and they are designed for grasping food, not chewing it.
2. The number of teeth varies considerably among individuals. On the average, Atlantic bottlenose have fewer teeth than the Pacific form.
   a. Atlantic: 80-92 teeth
   b. Pacific: 80-100 teeth

E. Cooperative hunting

1. Bottlenose dolphins cooperate when hunting and catching fish. In open waters, a dolphin pod will encircle a

large school of fish from all sides to herd them into a tight ball for easy feeding. Then singly the dolphins take turns charging through the school to feed.

2. Occasionally,dolphins will herd a school of fish against a sand bar to trap them in shallow water where they are easily fed upon.
3. Dolphins also feed at random on individual, non-schooling fish.

F. Migration patterns: Feeding habits and migration of fish probably account for the seasonal movements of dolphins to and from certain areas.

VIII. Reproduction

A. Sexual maturity: Dolphins become sexually mature at variable ages. The Pacific variety apparently becomes mature a little earlier than the Atlantic form.
   1. Females--Pacific 3-6 years
      Atlantic 6-8 years
   2. Males--Pacific & Atlantic generally about 12 years

B. Breeding
   1. Females seem to be sexually receptive during a large part of the year, and are generally responsible for initiating courtship and breeding behavior.
   2. Certain breeding seasons, however, have been extrapolated from statistics on calving times. These measurements indicate that there are two breeding seasons for Pacific bottlenose, in the spring (March-May) and in the fall. Those females not impregnated during the first season may breed in the fall. The Atlantic form varies in its breeding season with its distribution along the coasts.

C. Calving
   1. Gestation: 11-12 months
   2. Usually a single calf is born every other year.
   3. The baby is born tail first (breech) which helps to minimize the time that is is in the water before it can surface to take its first breath. Calving takes usually less than an hour.
   4. At the time of delivery, sometimes an assisting female or "auntie" dolphin stays close to hold the baby at the surface if something goes wrong in the delivery.
   5. New born calves are usually born in the spring and summer although calves have been observed throughout the year.

D. Care of the young
   1. Calves are nursed for a year or more (12-18 months) although the baby begins to take a few fish at about 6 months when its teeth begin to develop.
   2. Nursing takes place underwater. The mother nurses by contracting her mammary muscles and forcibly squirting milk into the calf's mouth.
   3. The mother's milk is very rich (16.7% fat; 9.6% protein; 71.4% water and traces of lactose and ash) so that the baby rapidly develops a thick insulative layer of blubber.

4. The mother dolphin takes very good care of her baby, staying close and attentively directing her baby's movements. The baby swims close to its mother and is carried in the mother's "slip stream", a type of hydrodynamic wake which develops as the mother swims. This helps the baby to swim and enables the mother and calf to stay up with the herd.

IX. Longevity: Some bottlenose dolphins may live up to 25-30 years.

X. Social Behavior

A. Bottlenose dolphins are very social animals. Living in family groups called pods, they exhibit a definite social organization and numerous social behaviors.

B. Most frequently bottlenose live in pods of less than 10-12 individuals. Herds are made up of several of these pods. Common are herds of up to 100 animals, and up to several hundred animals have been reported to travel in one herd.

C. Small family units conform to a definite organization with the dominant animals directing the activities of the unit.
   1. Often pods consist of several mature females, their offspring (up to 2 years old), large adult males and several subadult males and females who usually swim at the periphery of the pod.
   2. Other groups are sometimes made up of juveniles which, depending on the group, may be all of one sex.

E. Protection and aid for family members--dolphins aid ill or injured animals, particularly young and females.
   1. Standing by--herd members stay close to an injured or restrained member, often vocalizing.
   2. Actual physical support--when an animal is injured or unable to surface for air, other dolphins will support it at the surface so it can breathe.

F. Types of play: Both young and old dolphins engage in considerable play, chasing one another, nosing and carrying objects around, tossing seaweed to each other and using objects to tease each other and as invitations to play. Such play is theorized to be practice for catching food.

G. Strong social bonds are established among dolphins in a pod. Behavioral studies suggest that certain animals prefer association with each other and recognize each other after periods of separation.

H. Work together and defend each other.
   1. Hunt cooperatively.
   2. Scouts--In times of danger, apparently certain dolphins act as scouts to examine a situation and direct action when it is warranted. These sentinels appear to be subadult males who are not important reproductively to herd survival.

XI. Communication

A. Dolphins utilize a wide variety of sound and visual motions

B. Sounds dolphins make

1. Low frequency: The bottlenose has no vocal cords, but instead makes use of its blowhole and air sacs to make many different types of sounds. These include barks, grunts, squeaks, squawks and whistles (often within man's hearing range). The mechanism for making these sounds is similar to that for making a rubber balloon squeak: by constricting the opening. The thick muscular flap covering the blowhole is altered to produce these sounds. All such sounds are thought to convey moods, physiological states, location and identity.
2. High frequency: Dolphins are capable of making high frequency clicking sounds by passing air back and forth through their sacs. These are used primarily for echolocation. The frequency spectrum of a sonar click has been measured from 200 Hz to 150 kHz with peak energy between 30 to 60 kHz. The frequency components within human hearing range produce a grating or rasping sound.

C. Visual displays

1. Lobtailing: Slapping the water with tail flukes is done to produce a sonic report that can be heard great distances, both in and out of the water. It is thought to also indicate displeasure.
2. Jaw snapping: Used to possibly indicate displeasure; often adult, dominant animals assert their superiority by snapping at impertinent younger animals.
3. Sneezes and coughs: Probably serve the same purpose as in humans.

XII. Senses

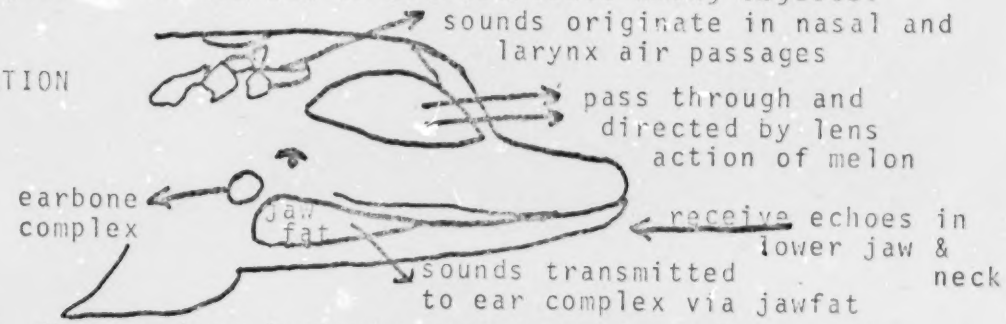
A. Hearing: By far the most developed and essential sense for the dolphin is its hearing.

1. External ear opening: This is a small opening a few inches behind the eye and it is thought to be most sensitive to lower frequency sound waves.
2. Lower jawbone: The lower jawbone of most cetaceans, broadens at its base, where it hinges with the skull. Directly beneath this very thin bone there is a fat deposit that extends back to the ear bone complex. It is thought that sounds, particularly high frequency, are received and conducted through this lower jaw and neck region to the inner ear and on to higher hearing centers in the brain.
3. Hearing range has been determined to be greatly sensitive between 15-75 kHz with a rapid decline in sensitivity above 120 kHA. It has been tested to 153 kHz where a response was indicated.

B. Echolocation: This term refers to a "sonar" ability that these dolphins possess (along with all of its toothed relatives). This enables them to essentially "see" with

their ear. By sending out high frequency clicks through its melon (the forehead area filled with fat which acts as an acoustical lens) and then listening for the echoes to return, the dolphins are able to find food in murky waters or in nighttime travel and to differentiate among objects.

ECHOLOCATION PROCESS


sounds originate in nasal and larynx air passages
pass through and directed by lens action of melon
earbone complex
jaw fat
receive echoes in lower jaw & neck
sounds transmitted to ear complex via jawfat

C. Eyesight: Observations indicate that dolphins have very fine sight both in and out of the water.
   1. Eyes are located on each side of the head, just behind and above the mouth. Eye movements are coordinated, suggesting stereoscopic (three dimensional) vision.
   2. Eyes are protected from the salt water by a jelly-like mucus resembling tears.

D. Smell and taste: The portion of the dolphin brain associated with smell is not developed, indicating that the animals lack a sense for smell. The area for taste is present, indicating that they can taste.

E. Touch: Although they have a very thick layer of skin and blubber covering their bodies dolphins are very sensitive to touch and this sensitivity serves a valuable function in breeding and courting activities.

XIII. Physiology

A. Heart rate
   1. The heart beat rate varies greatly with the kind of activity and the animal's size. Generally, larger animals have a little slower heart beat than smaller ones. The heart beat is adjusted according to the activity. Dolphins, as well as other animals, have a slower heart beat rate while diving. One Pacific bottlenose, trained to dive to 6 feet for 4 minutes, exhibited a change in rate from 90 beats per minute (bpm) to 12 bpm, which then slowly increased to nearly 20 bpm as the dive continued. This one adaptation, along with others, enables the dolphin to conserve oxygen while it is underwater.

B. Respiration: Breathing is a voluntary response, that is, it is not automatic as in terrestrial animals. This is a necessary modification since they do have to go to the surface for a breath--otherwise they might take a breath underwater.

C. Sleep: Resting dolphins normally stay very close to the surface in a semi-alert state. This allows it to continue breathing, periodically rising to the surface and also enables them to remain aware of their surroundings. (One unusual juvenile was observed resting on its back with both flippers sticking up into the air, rolling on its back to breathe.)

XIV. Miscellaneous

A. These animals have very few natural enemies. Killer whales and sharks may occasionally attack bottlenose.

B. Occasionally, bottlenose dolphins are found in association with other whales off the California coast. They have been reported to travel with pilot whales, possibly taking advantage of the hunting capabilities of the larger whales (and thus acting as a social parasite, eating the food found by the whales).

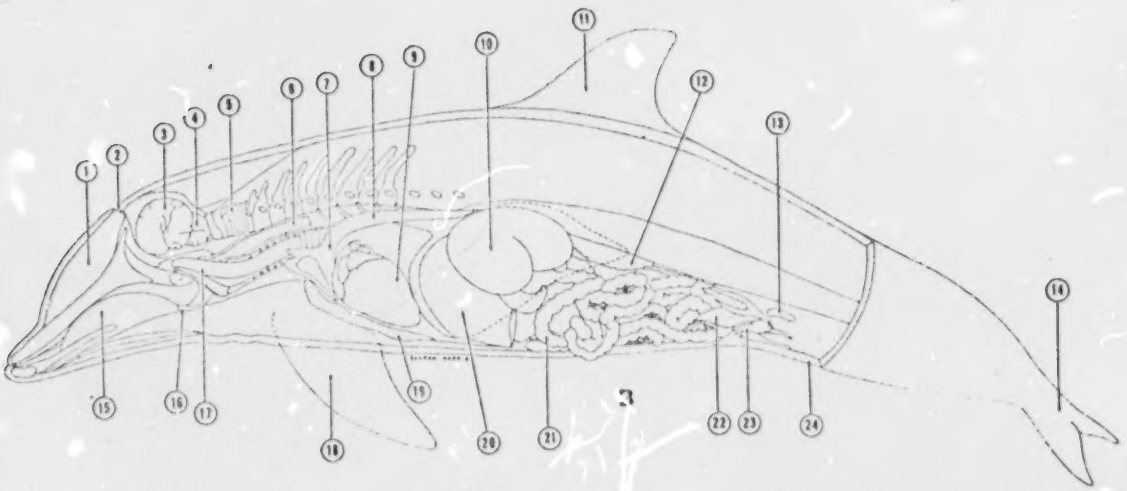


Figure 4-1B. Outline drawing of Fig. 4-1A with labels (outline drawn by Sharon Harris). (1) Melon, (2) Blowhole, (3) Cerebrum, (4) Cerebellum, (5) Cervical Vertebrae, (6) Esophagus, (7) Aortic Arch, (8) Dorsal Aorta, (9) Heart, (10) Stomach, (11) Dorsal Fin, (12) Kidney, (13) Pelvis, (14) Flukes, (15) Tongue, (16) Hyoid Bone, (17) Larynx, (18) Right Flipper, (19) Sternum, (20) Liver, (21) Intestine, (22) Urinary Bladder, (23) Penis, and (24) Blubber (hypodermis).

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WALRUS FACT SHEET

SEA WORLD EDUCATION DEPARTMENT

1974

WALRUS INFORMATION SHEET December 1974

I. Scientific name- Odobenus rosmarus

A. Belongs to the scientific order Pinnipedia (along with the seals and sea lions).

B. Family name- Odobenidae means "he who walks (baino) with his teeth (odos)". The common name is derived from the Swedish "hvalros" meaning "whale horse".

C. Two subspecies exist within the Odobenidae family:

1. O.r. rosmarus- Atlantic walrus- with shorter tusks, narrower facial region.
2. O.r. divergens- Pacific Walrus- generally a little larger; tusks "diverging" inward slightly.

D. Wally and Wanda, and the babies are all Pacific walruses collected off the coast of Alaska at age roughly 3 weeks.

II. Population and Districution

A. Both subspecies are circumpolar, Arctic dwellers, associated with the ice front in northern seas. Some, however, migrate as far as 1000 miles south of the ice pack in the summer, and some, 500 miles north in the winter. The majority exist in areas where the mean temperature is -15°C to +5°C.

B. The world population is distributed into a number of fairly distinct geographical groups. These are:

Pacific Walrus
a. The Bering and Chukchi Seas (between Alaska & Russia)
b. Laptev Sea (north of Siberia)

Atlantic Walrus
c. Barents & Kara Seas (Northeast of Norway)
d. From Baffin Bay to Labrador (east of Canada)
e. Isolated off the northeast coast of Greenland.

C. Estimate of world population: 90,000-125,000 (including Pacific and Atlantic).

D. Usually they are found in shallow waters of the continental shelf close to rich shellfish feeding beds (no deeper than 300 ft.). They stay close to land or ice floes (where they haul-out to rest), unless migrating to seasonal feeding grounds.

E. Distribution varies with many factors including:

1. Shellfish availability--numbers and types of clams
2. Seasonal overlay of ice and variable ice drift
3. Weather changes (ie. storms and rough water).

F. Many walruses migrate north in the spring and south in the winter as the ice recedes and advances. Often, they ride ice floes in migration, but their movements are sufficiently directional that they abandon ice when it strays from their intended course. Migrating groups are often segregated by sex.

G. Walruses have been known to travel over land in snow as far as 15-20 miles (when forced out of water by stormy weather) although this is rarely observed now.

III. Size

A. Among marine mammals, only whales and bull elephant seals are larger than walruses. (Enormous size is a cold water adaptation and helps to conserve body heat.)

B. Pacific walruses, generally, are larger than the Atlantic walruses.

1. Bulls: Pacific bulls can grow to be about 12 ft. in length and over 3000 lbs. Atlantic bulls, usually are about 10 ft. and over 2000 lbs.

2. Cows: Range from 8-10 ft. long and are usually only 2/3 as heavy as the bulls. (1500-2000 lbs.)

3. The difference in weight between the sexes is mainly because the males have a much thicker girth of insulating blubber.

C. At birth the calf measures between 3-4 ft., and weighs between 100-150 lbs. (About the same size as an adult ringed seal.)

IV. Longevity

Walruses can live to be 16-20 years old and rarely as old as 40 years. Generally females live to be older than the males.

V. Description

A. Distinctively characterized by a square head, conspicuous bristly moustache, and long tusks (often over 3 ft. long on very old walruses). The female's tusks are usually more curved than the male's.

B. Walruses have the spindel-shaped body, characteristic of Pinnipeds.

C. The skin is very thick (up to 2") and hangs in heavy folds (especially wrinkled and folded when born), and is covered by a scanty coat of reddish-brown hair which thins out as the animal ages.

D. Walruses' coloration varies with activity. After a long dive, while the blood is shunted away from the skin and only to internal organs, they become a bluish-white. Yet, after hauling-out, their skin becomes a bright pink (believed to be sunburn by early northern travelers). This coloration is due to the shunting of blood to the vessels just beneath the skin. This "vaso-dilation" serves to cool the animals, by delivering blood to the skin to be cooled by the outside air. This heat exchange helps keep the animal from overheating while lying in the sun.

VI. Aquatic Adaptations

A. Walruses possess typical Pinniped swimming and diving adaptations. (And seemingly represent an intermediate stage between the seal and sea lion evolution in their aquatic and land adaptations.)

B. They have a torpedo-shaped body, streamlined for efficient swimming. All external genitalia are withdrawn and the four female mammary glands are recessed into skin folds. External ears are missing--apparent only as elevated areas behind the eyes (similar to those of the seals).

C. Limbs are modified for swimming--all four limbs are modified as flippers. Bone stucture of limbs is similar to that of land mammals, yet the basis of the limbs are enclosed within the body up to the elbows and knees. The hand and foot are elongated and flattened to comprise the entire external appendage. Each limb has 5 digits, broadly webbed by a thick flap of skin.

D. Like the sea lion, walruses have hind flippers that can be folded forward (under them) to facilitate movement on land. However, more like the seal, the walrus primarily uses its hind flippers for propulsion in water.

E. Also, the walruses' long front flippers are similar to those of the sea lions', (¼ of the length of their bodies) and are used for swimming.

F. The palms of the flippers are calloused and roughened to provide traction on the ice.

G. Their blubber lining (characteristic of most marine mammals) is more than 6" thick in some places, especially during the coldest part of the year. This layer serves several essential functions:

1. In buoyancy
2. As a source of reserve energy during lactation and migration (although walruses do not fast like many other Pinnipeds during migrations.)
3. In thermal insulation (conserving their body heat).
4. As padding for body streamlining.

H. Diving adaptations are similar to those of other diving marine mammals:

1. Great oxygen capacity--Lungs have a greater tidal volume than most land mammals; blood is rich in hemoglobin; muscles are well furnished with myoglobin. (Generally there is a more efficient availability and utilization of oxygen.)

2. Regulated heart rate--While diving the heart rate can slow to between 4-15 beats/min. (Normally it is between 40-150).

3. Overall body temperature while diving can be decreased by as much as 4 degrees C. (Normally land mammals must be very ill to have such a temperature decrease occur.)

VII. Swimming and Diving Ability

A. Walruses are very graceful and agile swimmers.

B. They can swim up to 15 mph, though their maximum speed for traveling any distance is 6-7 mph. (Therefore, they can swim about a mile at cruising speed before they have to breathe.)

C. In swimming walruses primarily use a lateral, rudder-like motion of the hind flippers (similar to the swimming pattern of seals). For fast swimming, they combine this with a front flipper, reverse breast-stroke-type movement (like that of sea lions).

D. They can dive to feeding beds at depths of 300 ft., and stay submerged up to 10 min. After such a long dive, it is usually necessary to rest at the surface or haul-out to rest.

E. While hauled-out (after diving) they hyperventilate for CO_2 exchange.

VII. Feeding Habits

A. Walruses are benthic grazers--feeding primarily upon bottom organisms such as clams, snails, tunicates and worms. Three commonly eaten mollusks are: Mya runcata, Suzicava arctica, Cardium groenlandicum.

B. Feeding in the wild occurs normally just before noon and in the evening, although they can feed any time.

C. Dentition

1. Dentition is highly variable between individuals, but normally is: i 1/0, c 1/1, pm 3/3, m 0/0=18. This means that in the upper gum there are 2 incisors, 2 canine (elongated as tusks), and 6 premolars. The lower dentition is the same except that there are no incisors.

2. The blunt, flattened cheek-teeth (premolars) are probably specialized for crushing mollusk shells.

3. Walrus dentition suggests that the food is not chewed but swallowed whole. (This is observable when Wally and Wanda eat.)

D. Tusks

1. The canine teeth of the upper gum (the tusks) are one of the most distinctive features of the walrus. They begin to develop at about 4 months.

2. Size: male's can be 3½ feet long and weigh up to 12 lbs. the female's can be 2 feet, and 6-8 lbs.

3. Composed mostly of dentine, the original enamel tip is worn off 2 years after eruption (by plowing in the sand). Since this cap is not present, the dentine continues to grow throughout the animal's life.

4. The tusks are used to aid the animal in hauling-out onto ice floes. Hooking them over the edge of the ice, it can lever itself out of the water. (The scientific name refers to this usage.)

5. The tusks are thought also to serve in digging up food. (However, this is a subject of debate.) The uniform manner in which the ends are rounded suggests they are polished down by a uniform substrate such as mud or sand. (If they were used mostly for hauling onto ice, the tusks would be flat on the bottom.)

6. Tusks also serve in defense and for carrying the young.

E. Method of Feeding

It is believed that walruses dive to shellfish beds, 120-300 ft. down, to locate clams. They plow up the ocean floor with their tusks and collect the clams together with their whiskers. Then, either by sucking the meat from the shell or crushing the shells with flattened premolars, they eat the meats. This is all completed in less than 10 min. and very efficiently done, since rarely are any shells swallowed with the meats, or brought to the surface.

F. Confusion About Feeding

1. Old walruses, missing one or both tusks, show no evidence of feeding difficulties. This tends to indicate that the tusks are not absolutely necessary for feeding.

2. However, young walruses nurse for almost 2 years until their tusks begin to develop, even though they are capable of diving for food at age 2 wks.

3. Whether the meats are sucked from the oyster shells or the shells are cracked by flattened premolars is not definitely known. Possibly, a combination of both occurs. Walruses do have tremendous sucking capabilities, yet it is questionable if this method would be very efficient. On the other hand, the premolar specialization suggests that the shells are crushed (yet why very few shells are ever ingested is unexplained-- investigation is needed.)

G. Dietary Oddities

1. Rocks are often found in walruses' stomachs, possibly to aid in digestion or to supply bulk against hunger pains.

2. Carnivorous walrus--("layin-quuk") There are several documented cases of walruses that diverge from the normal feeding patterns. Instances of the remains of young ringed seals or bearded seals, beluga, and narwhal whales being found in walruses' stomachs have been reported. Apparently, such seal-eating walruses are easily recognizable by their yellow, grease stained skin.

H. It is noteworthy to mention that such immense animals flourish on a diet consisting almost exclusively of clams. The success of the walrus is due, in part, to the fact that there is little competition from other animals for the food that it eats (as well as very few predators).

IX. Reproduction

A. Specific breeding data on walruses is scanty. Since breeding is rarely observed, it is thought to occur exclusively in the marine habitat, away from the "uglit" (that is the hauling-out areas).

B. Sexual maturity is reached by the age of 7-8 yrs. by both male and female.

C. Although polygamous, walruses do not have the highly-evolved harem structure of sea lions and elephant seals.

D. Breeding season is thought to occur between Feb.-Mar. Normally a female breeds only once every 2 yrs. (Older females generally less frequently.)

E. Delayed implantation--occurring in most Pinnipeds, apparently does not occur in walruses. Embryos found in pregnant females in August are probably too large for a delay to have occurred. (More data and investigation is necessary.)

F. After a gestation period of 12-14 months, the female generally gives birth to a single pup between April and May. The pup is capable of swimming immediately after birth.

X. Behavior

A. Social behavior

1. Walruses are very gregarious animals, most commonly associated in herds. (Only 3% are reported alone.) Herd numbers are highly variable--from a few individuals to several hundred members. Mean group size is smallest when in the water, larger when on ice, largest on land.

2. Herds are often grouped by sex, though they are occasionally composed of both male and female animals. (Definite generalizations are impossible from current data.)

3. Walruses are very protective of herd members, and will defend each other viciously. The young are especially protected. One and two year old calves are very aggressive and protective while defending an endangered or orphaned calf, and will often drag it into the water away from danger.

4. The female walrus is among the most solicitous of mothers, and nurses for between 18-24 months. She

often carries her young clasped to her breast by her flipper, or clinging to her neck during the long spring migrations.

B. Thermoregulatory Behavior

1. While hauled-out onto ice floes or land, and exposed to atmospheric conditions (ie. warming sunlight and wind), walruses employ behavioral methods to regulate body temperature.

2. Such responses as huddling, posture changing, and selection of a resting substrate, all help regulate the exposure of body surface and appendages to air (helping control body temperature to a degree).

3. Huddling is characteristic of every group of hauled-out animals. Usually the extent of contact between group members is about 20% of the total body surface per animal. The extent of huddling does not vary with air temperatures, and it probably increases heat discomfort as air temperatures increase.

4. Another type of huddling (brooding) is displayed by mothers and calves. The extent that brooding occurs does vary with the weather. In cold weather the calf is held between the mother's flippers with 50% of its skin in contact with the female's.

5. Posture and fanning are two means of adjusting the amount of surface exposed to cooling air. Maximum exposure is attained by the walrus by sprawling on its back with head and neck extended, and flippers outstretched and fanning. This position is maintained in warm weather. Minimum exposure is accomplished by a "fetal" positioning which exposes only 3/4 as much surface area to the air.

6. Apparently walruses prefer to haul-out in sunny weather and seem to stay in the water during windy or stormy weather.

C. Hauling-out

The principle benefit of hauling-out is probably derived from the warming of the skin and appendages. While the animal is in the water, it is thought that the skin is probably in a semi-dormant state (only a few degrees above the freezing water temperatures). The relatively high skin temperatures attained by basking in the sun, makes it possible for skin tissues to become active, and growth and regeneration to occur.

XI. Communication

A. Walruses have one of the loudest voices in the Arctic. The strong abrupt bellow and occasional bark can be heard several miles away on calm days, and probably serves the animals in locating one another while swimming.

B. Wally is a very vocal animal, often making gurgling, sputtering, and motor-boat like sounds in his pool.

C. Pharyngeal (throat) pouches--(occuring primarily in adult males) are not found in any other Pinniped. They are used to produce a unique "bell sound" (similar to a far-away clang), deep in the throat region. The significance of this sound is unknown (possibly serving in some reproductive function), yet it seems to display pleasure. Possibly, too, these pouches, inflated with air, serve as a floatation device when sleeping.

XII. Senses

A. Sight--eyes are small, usually bloodshot, and can be forwardly directed by rotation within the sockets. Their near-sightedness has possibly been over-stressed, though they are myopic to a certain degree.

B. Smell--is believed to be the most developed sense-relied upon for warning of danger when hauled-out. If approached down-wind by a predator, they will abandon the "uglit" before the predator is in sight.

C. Hearing--when hauled-out most sounds are obliterated by the noise of the herd and sea, yet, when in the water, this sense is thought to be very sensitive.

D. Touch--extremely sensitive sense of touch is concentrated in the whiskers. This moustache is comprised of vibrisae (up to 400 plastic-like bristles) embedded in the fleshy nose pad. Each vibrisae is richly supplied by its own nerve and blood supply, and serves the walruses much as our fingers serve us.

E. The walruses' skin is very thick and not particularly sensitive to touch--although Wally happily responds to a hearty back slapping.

F. Accurate evaluation of the senses for wild animals is difficult to make, and it depends totally upon behavioral responses to stimuli. If a stimulus is foreign, it may elicit little or no response. Such a lack of response does not indicate a poorly developed sense, but

merely a lack of familiarity with the stimulus. One way for evaluating an animal's capabilities (ie. for learning, sensing etc.) is by a comparative study of brain area development.

XIII. General Physiology

A. Heart rate varies considerably according to the type of activity and environmental conditions the animal is in. The rate slows when hauled-out, and as the temperature increases. Also, as the animal dives, the rate declines (normally it varies from 40-150 bts/min.)

B. Respiration

1. Each breath constitutes a voluntary response. The fleshy nose pad (rhinarium) is elastic and valvular, and normally is closed between breaths. The animal must consciously open it to breathe.

2. The diaphragm slants backward in the walrus, from the back bone toward the sternum, not vertical as in most land mammals.

C. Activity cycle--Activity measured in both captive and wild animals shows a general circadian rythym--that is a daily cycle. In the forenoon and evening walruses tend to be most active, hauling-out early in the morning and early afternoon.

D. Metabolism

Walruses have a very high metabolic rate (as well as a rapid rate of digestion) in order to maintain high body temberatures of 36.6 degrees C. Calves usually have highter temperatures and faster metabolism to account for the rapid growth rate of 37 lbs. and 4-5 inches per month.

E. Sleep

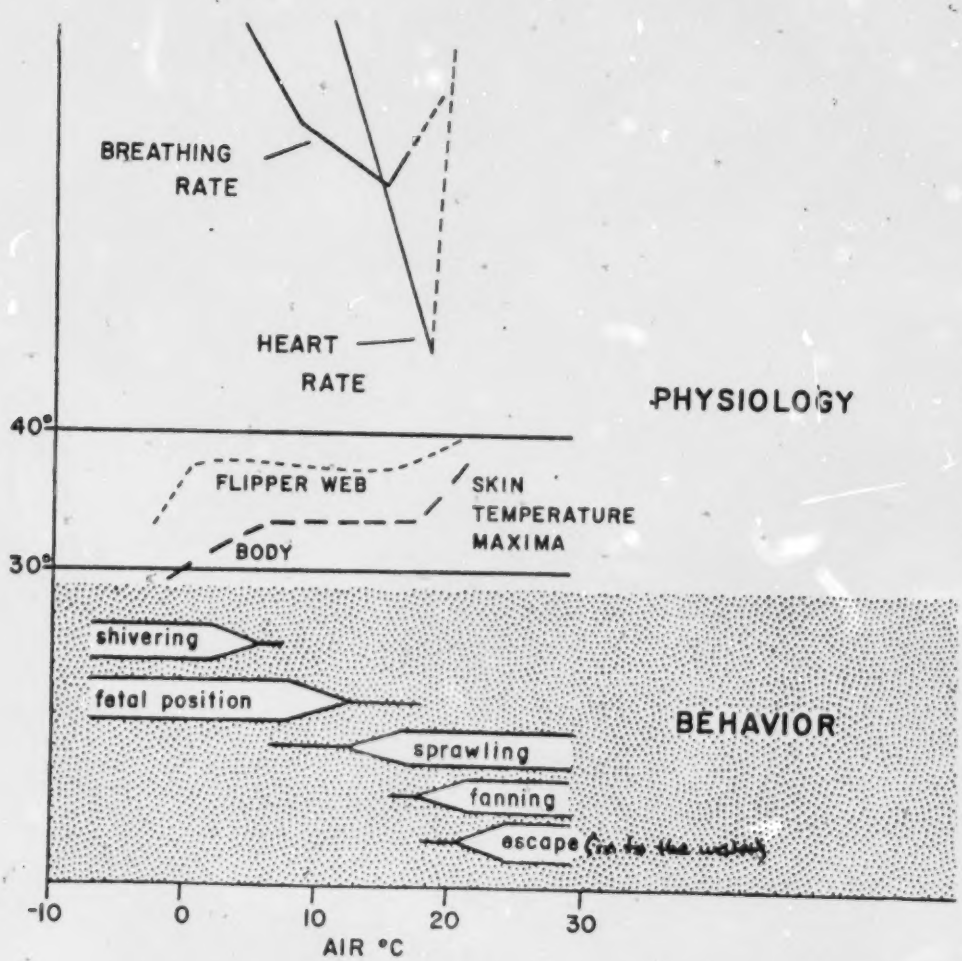
Walruses are capable of sleeping in the water and frequently do so, yet at certain times, they are more inclined to rest on land.

F. Tears--Murky tears lubricate the eyes, especially when out of the water. This continuous trickle of salty tears also helps to maintain the walruses' internal water-salt balance.

G. Thermoregulatory Physiology

Besides having behavioral adjustments to compensate for temperature extremes, walrus physiology adjusts to counter adverse body temperatures. With increasing heat, breathing rate decreases along with heart rate. The capillaries close to the skin and flippers dialate so that the blood shunted to these areas is cooled. Although the skin temperature increases overall, the flippers particularly can attain elevated temperatures.

Refer to the following graph for a summary of the mechanisms that enable the walrus to bask its enormous, blubber-insulated body in the sun, without overheating.



TEXT-FIG. 8. Correlation between characteristic physiological and behavioral responses of newly captured walrus calves and ambient still air temperatures in shade.

H. Heat absorption when hauled-out is an important phenomenon to the walrus. The warming effect of sunbathing and its function in skin repair is discussed under hauling-out. (X-C)

XIV. Protected and Studied

A. Marine Mammal Act: Walruses are protected the Marine Mammal Act of 1972. Strict regulations are maintained to insure continued population growth and prosperity.

B. Currently, this animal is being investigated and yearly scientists learn more about these lovable, Arctic dwellers.

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HARBOR SEAL INFORMATION SHEET

SEA WORLD EDUCATION DEPARTMENT

1975

HARBOR SEAL INFORMATION SHEET

I. Classification

A. Scientific name: Phoca vitulina
   1. Belongs to the scientific order Pinnipedia (along with sea lions and walruses)
   2. Name Pinnipedia means feather-footed. These air-breathing animals have limbs modified for swimming.
   3. Origin of Pinnipedia order--the skeleton and limb structure show that these mammals once lived terrestrially with four articulate limbs and were able to walk on land. However, no connecting link with the terrestrial forms has been found. The oldest pinniped remains are from the Miocene period. Two main groups are recognizable from these: walking ones with a swimming mechanism near the forebody and crawling ones with a swimming mechanism near the hind body. This leads some zoologists to believe the family tree has two trunks instead of one.

B. Common names: harbor, spotted, hair, common

C. Subspecies--There are five which are found in the temperate marine waters of the northern hemisphere. The differences among the species are thought to be primarily geographical although some claim the heads of the Atlantic and Pacific seals are distinguishable

II. Habitat and population distribution

A. Shore-living animal which prefers estuaries, rivers and areas where sand bars, beaches or rocks are uncovered at low tide for hauling out. No definite migrations but will move in search of food.

B. Distribution in the northern hemisphere of the five sub-species
   1. Pacific species
      a. P.v. richardi--along the eastern Pacific from Herschell Island in the Arctic, the eastern Bering Sea and along the coasts of Alaska, British Columbia, the western United States and Baja Calif.
      b. P.v. largha--western Pacific
   2. Atlantic species
      a. P.v. vitulina--eastern Atlantic
      b. P.v. concolor--western Atlantic
   3. Landlocked species--P.v. mellonae in the Seal Lakes, Quebec, Canada

C. Numbers: 1972 estimate between 50,000 and 200,000 seals, approximately 500 in California

III. Physical Description

A. Size varies among the sub-species. The Alaskan seals tend to be somewhat larger than the seals found off the California coast. Therefore, size estimates cover the range of lengths and weights considering all species.

Pups at birth: 16-34 inches (406-863 mm); 10-25 lbs. (4.5-11 kg) Males and females grow at same rate until about 5 years of age when females stop growing; males continue growing until 10 years of age.
Males at maturity: 5-6 feet (1.5-1.8 m); 250-300 lbs. (112-135 kg)
Females at maturity: 4-5 feet (1.2-1.5 m); 200-250 lbs. (90-113 kg)

B. Coloration--near white to brown to black, but most often bluish gray with black spots and irregular white rings and loops.

C. General body appearance--evolved primarily in response to cold, marine environment.
   1. Chubby and fusiform shape enveloped with subcutaneous fat.
   2. Rounded head with almost snub nose; face cat-like with nostrils close together forming a V; no external ear only earhole.
   3. Fore and hind limbs are webbed, hairy flippers; long limb bones are greatly reduced and most of the limb is retained in the body leaving the flippers protruding; hind limbs cannot be rotated forward and the forelimb digits have noticeable claws.
   4. Short tail not used in swimming is tucked between hind flippers.
   5. Teeth-front ones are pointed and sharp, adapted for catching, tearing and swallowing as opposed to holding and chewing; back molars are cusped for crushing shells and crustaceans; has 34 teeth, less than most carnivores.

D. Longevity--life span estimated up to 29 years for some specimens in the wild, although few ages have been recorded. Age can be estimated by sectioning teeth and counting annual ridges or bands of dentine and cementum laid down.

IV. Physical adaptations to cold, marine environment

A. Blubber--thick layer
   1. Provides thermal insulation.
   2. Reserve food during long fasts and lactation periods.
   3. Adds to buoyancy in water and in filling out skeleton for body streamlining.

B. Hairy covering
   1. Short, thick hair. Mixture of thick rather coarse overhairs about 1 centimeter long covering a dense inner stratum of hairs almost as coarse but half as long. Each overhair has 4 or more underhairs attached to root.
   2. Molt--seals molt once a year in the late summer. Seals lose their hair gradually in patches. Females molt after pup birth and weaning. Pups molt a white coat while still in womb or shortly after. It will not molt again until it is a year old. No eating or mating takes place during molting.

C. Sweat glands under thick epidermal skin exude an oily fluid which helps to waterproof body.

D. High metabolic rate keeps body warm.

E. Blood circulation--seals have 1½ times more blood in volume than man. Numerous veins in surface layer of flesh and blubber.

As the ambient temperature decreases, the skin arterioles contract and the skin cools down to about 1 degree warmer than the water. This is sufficient to prevent animals from freezing and heat from leaving the body; a steep gradient is then created between the skin with a lower temperature and about 1½ inches deep in the body where the temperature is higher and constant. This insulation means seals do not have to increase their metabolic rates to keep warm which, in turn, would generate a need for more oxygen. The body can be cooled by relaxing arterioles and warming up the skin with the blood. Heat is transferred from the blood to the air so that the seal can cool down.

F. Flippers--each of the four limbs have five digits which are webbed. There is no thumb and none of the digits can be moved separately, but have to be moved as one instrument. The foreflipper and hind flipper digits have narrow claws from 1 to 2 inches (25-50 mm) which are bluntly pointed.
   1. Forelimbs--forearm attached without a collar bone so that it lies flush with body wall and presents little resistance to water; it is not as broad a surface as the hind limbs. The claws on forelimbs are used to grip things; they are used with a very mobile arm for scratching and preening almost every part of the body.
   2. Hind flippers--first and fifth digits are long and stout to support the arc of fleshy web, whereas the other digits are shorter and thinner. When the flipper is fully spread, it resembles a wide fan. Efficient as a steering rudder and propellor, hind flippers are used mainly for swimming as they cannot be rotated forward to help in movements on land. They also cannot grip or hold things but they can be curled up.

G. Eyes--fluids wash over the eyes continually to protect them but seals lack a nasolacriminal duct to drain eye fluids into the nose. This is not needed because of its mainly aquatic environment and this is why the eyes are rimmed with tears out of the water. Eyelids protect eyes.

H. Ears--the orifice closes by a muscle when the seal dives.

V. Diving ability--since marine life is their food source, seals dive for their food and have been observed to dive to depths in excess of 300 feet (90 metres). An adult's average dive is 7-10 minutes and a pup's is 2-4 minutes, however, dives can be extended if necessary.

A. Nostrils are closed naturally to hold breath and consciously opened to breathe. Pressure against the nasal cartilage by the moustachial pad and water pressure closes the nostrils. They are opened by a muscular contraction which lifts the moustachial pad.

B. Breathes out on a dive so that the amount of air in the lungs is reduced. This makes the animal less buoyant and also effectually collapses the lower lung. The remainder of the air is then kept in the rigid, less absorptive parts. The seal is then not as susceptible to the bends because it is receiving less air and therefore less nitrogen.

C. A seal has more blood than other mammals its size, therefore

more oxygen is available to it. It also has high myoglobin levels (oxygen carriers in the blood). Both of these factors help to prevent tetany, or muscle oxygen deficiency while the seal dives. Oxygen is conserved in diving by vasoconstricting all peripheral blood vessels and limiting the blood supply to vital organs--heart, lungs, kidneys, brain and intestine; the extremities use up available oxygen and then switch over to glycogen or starch stored in the muscles which the body burns up without oxygen. The heart beat slows from 85-120 beats per minute to 6-20 beats under the water. When the seal surfaces, the heart beat shoots up to about 160/minute. The seal also has a higher tolerance level for carbon dioxide.

IV. Locomotion--one of the major differences among pinnipeds.

A. In water--uses 4 webbed limbs, propelling by lateral movements of the lower body and hind flippers. Foreflippers are efficient as a steering rudder. Can swim forwards and at angles and upside down, but rarely backwards. Clocked at 9 knots average with 15 upon pursuit.

1. High speed--foreflipper pressed tightly against body; propulsion by swimming-lashing movement of the back half of the body. Hind flippers are spread wide but pressed together so they form a vertical rudder; moves with swift lateral thrusts of thighs and hind flippers. Can go short distances at dolphin-like speeds.
2. Normal or moderate speed--seal carries foreflippers close to body with tips projecting beneath. Hind flippers are lashed open and shut in wider swinging movements. Can swim equally as well this way as on its back.
3. Slow speed--seal uses foreflippers as stabilizers swinging them in short circles with paddle-like motion fanning water towards the body. Hind flippers are vertical and separated from ech other and swung from side to side with a slow, twisting, graceful motion of thighs, each flipper half-closing and opening alternately.

B. Land--movement fairly restricted on land. Moves by levering body forward in a series of rowing movements or by one hand after another alternately; head and upper body raised and levered forward by pressing hands, fingers, and claws, clenched or flat, into ground. Body then levered until breast touches ground. With the weight thus taken off the foreflippers, these are rowed forward for a new grip. On a smooth slope, can go faster than a man's walk.

VI. Food--swallows food whole, head first. If too large for one mouthful, the seal will thrash it into smaller chunks. Have rapid digestion, with soft fish passing through the stomach in a few hours. Likes mostly fish, some squid, crustaceans and molluscs. Eats between 5-20 pounds a day depending upon size. Stones are sometimes found in seal stomachs for reasons now unknown.

VII. Senses

A. Sight--front layer of the iris is transparent and is crossed by a network of blood vessels; eye is lubricated with tears; Underwater pupil expands into wide circle to let in as much light as possible. In the light, the pupil is contracted to a slit. Eyes are larger than man's and sight thought to be more acute than man's underwater but inferior on land. Blind seals have survived in the wild and in zoological collections for years.

B. Hearing--acute hearing underwater. Have responded in tests to sounds of 55 kHz though pitch discrimination is lost at about half of that level. In the air, measured at 12 kHz.

C. Scent--acute above water. Nostrils closed underwater so it is not known how acute this sense is underwater.

D. Whiskers--touch felt to be very important in sensing fish in the dark.

1. Upper lips of seal form a thick pad with a score of vibrissae deeply embedded on each side. These antennae continually grow and are highly tactile and sensitive. They are connected to the brain through a substantial nerve system.
2. Underwater, seals thrust pad in sweeping movement to and fro by pushing mobile upper lip in and out. Whiskers stand clear of face underwater except when moving fast. Any movement underwater sets up a vibration and current which is felt by the seal's whiskers. The whiskers are used involuntarily when out of the water.

VIII. Communication--Seals can make hissing sounds, snorts, and sneezes. Adults are quieter than the pups who coo often at their mother. Will occasionally make sounds at other seals in play and when they feel threatened. Seals also loudly slap the water and their body with foreflippers.

IX. Social behavior--generally a shy and retiring species which spends equal time on land and in the sea. Adults are solitary and rarely interact outside of sexual encounters, however, they haul out in loose groups with no organization. Prefer to return to the same hauling grounds so rarely wander far except in search of food.

A. Hauling ground behavior-rarely moves far from the sea as seals are awkward on land. The hauling ground is the hub of their life activities. The seals have a very low level of activity while on land. They do not like to be touching each other while in the grounds. If another seal does make contact, a flipper may be waved in the air at the intruder with an accompanying hiss or moan. Younger seals will play on the fringes and stay out of the way of the adults. Seals become less playful and tolerant of close contact the older they get though the pups will play with each other.

B. Sleep--will sleep on land or underwater. If underwater, the seal will come up to breathe every 5-10 minutes without waking up.

C. Characteristic resting pose in water is vertical hang with just head out of the water.

D. Reaction to danger--on land, the herd will raise heads and look in direction of danger. Some will go into the water while a nucleus of seals will stay ashore until danger is imminent. If danger doesn't materialize, those in the water will haul out again immediately. If in the water, the seals will dive sideways and slap the water with their foreflipper.

E. Aggressive interaction--audible growls with foreflipper raised in a threatening wave. More aggressive action is a head thrust or butt--a sharp, rapid extension and retraction of the neck with open mouth and growl. Fighting is rare.

X. Mating

A. Sexual maturity occurs between 3-5 years for the female and 5-6 years for the bull; female will not mate while nursing pup, but will after the pup is weaned, and at that time she enters estrus; mating takes place about 6 weeks after the pup is born, usually early fall. Seals prefer to return to the same breeding grounds.

B. Behavior

1. Spring--there is a period of boisterous play between couples, writhing and twisting, mouthing each other's napes, yelping and snarling, and slapping the water with foreflippers, but full coition observed rarely. This period ends with pupping season and begins again after molting is completed in the fall.

2. Fall--mating is marked by much pre-coital play. A bull will approach a cow and she will respond with growls, head thrusts and flipper waving. The bull will rush and grab her by the back of the neck and a fierce battle with the cow may ensue before copulation. The male will ride the back of the female, clasping her under the arms with his clawed foreflippers. They will roll and copulate by both twisting their hind-ends over sideways. It occurs generally in the water.

XI. Pregnancy and Birth--a female has 1 pup a year although twins have been reported rarely. Pupping season times vary with species, but is usually around midsummer. The seal will give birth in the water, ice, land or sand bars, depending on the location of the herd. The fetal growth time requires 9-10 months, but because of delayed implantation, the period from conception to birth is about 11 months.

A. Delayed implantation--True pregnancy begins in November to December, about 60 days after mating. This retardation of embryonic development (characteristic of many marine mammals and some bears) means the fertilized egg (zygote) remains in blastula (ball) stage of development for 1½-2 months, and then implants in the uterine wall where it begins full development. This delayed implantation means the pup is born in the season

of the best weather for survival. It also allows the mother time to get into good condition to nourish another embryo as she fasts during lactation and loses 1/4 of her weight.

B. Birth--Seal will give birth in water, land, ice or sand bars, depending on location of seal herd. The cow will jettison the calf head first from the womb so hard that the umbilical cord is severed. The placenta is ignored by the mother and left to the sea gulls.

XII. Pups

A. Size and description--About 16-34 inches long (406-863 mm) and 10-25 lbs. (4.5-11 kg) lean, lanky and long. Usually also molt white pre-natal coat while still in womb so coat is dark. Can swim from birth but remains very awkward on land for several weeks. About half born will survive.

B. Nursing

1. Female has two mammary glands on her low abdomen with teats which retract beneath the body surface except when in use. The sheet-like mammary glands are spread out like blubber over much of the body's ventral surface.
2. Seal milk is 45% fat, 10% protein, 45% water with traces of lactose and ash. This extremely high fat content in the milk is the reason the pups more than double their weight by their weaning time.

C. Relationship with mother--cow is devoted parent during the 4-8 week lactation period, but after that is no longer interested in her pup. She noses the pup often during this time and actively plays with it. The pup will ride on her back, nipping at her flippers and chasing his mother in the water. Mothers can recognize their pup by sound and smell and will not often adopt deserted pups.

D. Weaned pups--at the end of the lactation period, learns to eat prawns, shrimp and small rockfish. It does not wander far from the sea, river, estuary or sandbank frequented by the adults. It graduates from playing with its mother to playing with sticks and then other pups. In the spring the pups engage in the same courtship rituals as the adults, but often with others of the same sex, until they reach maturity.

XII. Major reasons for mortality

A. Predation--killer whales and some sharks and man

1. Seals used as food and clothing by Eskimos and primitive man. In the 1900's pups have been hunted for their coats because of the fine coat they have at about 4 weeks old. They are slow to perceive man as an enemy and slow on the ground so that they make easy prey.
2. Fishing competition--Seals do eat salmon, so bounties were placed on them because of the reputed damage they did to the salmon fishery. Seals were hunted extensively for this reason during 1940-1960 and soon abandoned some traditional hauling grounds.
3. Seals are now protected by law in the U.S. and British Columbia.

B. Natural causes
   1. Parasites--Have to occur in large numbers in an animal to do appreciable damage. Common parasites and the organs they infest are the gut: nematodes, acanthocephalans, trematodes, cestodes; the heart, lungs, blood vessels: nematodes; nasal cavity: mites; skin: ticks.
   2. Seal pup survival--mortality is extremely high in the first year. Causes: starvation; abandonment; washing away by heavy seas from hauling grounds; bacterial infection leading to lung infections; predators.

XIII. Legends--Norway considered the home of seal mythology
   A. Ron Mor is an Atlantic seal, a huge creature which has human qualities and is a familiar figure in British Isles folklore.
   B. Seals are believed to be the children of the King of Norway who are under a spell cast by their stepmother. The story goes that the stepmother was jealous of the children's beauty and spent 7 years and 7 days perfecting herself in the Black Art. She changed kids into seal form so their longing in the sea would be for land and their longing on land would be for the sea and the spell would last until the waves stop beating on the shore. Three times a year they are compelled for a brief space to regain their human form so their sorrow would remain undimmed. During one of these times a man of North Uist was walking along the shore and saw the seals casting off their furry coats. He picked up one of the coats and carried it home. Its owner saw him make off with her coat and she followed him. He gave her human clothing and married her, hiding the coat. Years afterward, one of the couple's children discovered the coat and showed it to his mother. She threw it about herself, sang a seal song, and became a seal again, diving into the ocean and leaving forever her human life.

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What is Behavior?

Behavior is the way an animal acts. Through evolution, marine mammals have become physically equipped to live in the water. They have also evolved ways of acting (behaving), which make it possible for them to survive in their environment, to find food and to reproduce.

INNATE BEHAVIOR — Built in Capabilities

Some behaviors are so essential for an animals survival that they have become inborn (innate or instinctive).

EXAMPLES:

Voluntary breathing—marine mammals hold their breath instinctively and must make a conscious effort to breathe.

Homing instinct—some marine mammals return each year, often across thousands of miles of open ocean, to breed in the same place; thus insuring they will meet others of their own kind, in a place proven favorable for raising their young.

Nursing instinct. Courting and mating instincts. Territorial defending behavior by males. Swimming ability in whales and dolphins which are born in the water, etc.

LEARNED BEHAVIOR—Trial and Error and Practice

Although physically equipped to live in the water, many behaviors necessary for survival must be learned; either from the mother or through play behavior with other juveniles during the time of growth and development.

EXAMPLES:

Swimming in pinnipeds (seals and sea lions) that are born on the land and must learn to swim.

Development of swimming skills and food catching behaviors.

Recognition of areas where food is to be found.

Recognition of communication signals within the group—danger warnings, food location signals, threatening or mating gestures and sounds, etc.

This learning process is through a trial and error system of imitating and experimenting, and then practicing. Whether or not a behavior is repeated depends on how rewarding it is. Marine mammals are extremely curious and find new objects and experiences challenging. Often they will initiate a new behavior as a game. If they are rewarded by catching something to eat, or with the pleasurable experience of having others join in the game, the behavior will be repeated and a new behavior will be learned.

TRAINED BEHAVIOR — An Extension of Natural Learning

In his natural environment, there is neither the necessity nor the opportunity for a marine mammal to learn many of the complex behaviors performed by trained animals. However, within the limits of its physical and mental capabilities, these complex new behaviors can be taught, by extending the animals natural learning processes.

The same principles of reinforcement of behavior, through positive rewards, or not reinforcing by the absence of rewards, is the key to behavioral training used by Sea World trainers in training marine mammals.

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Transparency 1 Marine Mammals on Land: Seals and Sea Lions

May be used to illustrate discussions and activities concerning the physical adaptations and behavioral characteristics of seals and sea lions when on land.

Some answers to the suggested questions are given. Encourage students to think of additional reasons by applying logical cause and effect thinking from other fields of experience. For example: Number 3—What are the advantages of social grouping for other animals and humans?

1. Locomotion on land:

Sea lions can rotate the hind flippers under their bodies, so they can "gallop" along on all four flippers.

Seals "hump" along undulating their bodies like caterpillars and pushing with their front flippers.

Q. Which animal has become more adapted to a marine environment?

A. Seals, cannot rotate hind flipper under body on land, but use them for efficient propulsion in water.

2. Play behavior — training for survival:

Sea lions toss and catch pebbles in their mouths.

Q. How might this be useful in catching food in the sea?

A. Catching and tearing fish into small pieces (have no chewing teeth).

Seal and Sea lion pups play mock battles, jousting chest-to-chest, weaving their necks, and nipping and barking.

Q. How will this behavior be used by adults?

A. Females protect young, males defend territory, protect and discipline harem and young.

3. Social Behavior:

During the breeding season and when sunning on the rocks, seals and sea lions group together.

Q. What are some of the advantages of this social behavior?

4. Rearing of Young:

Seals and Sea lions must return to the land to rear their young.

Q. Why do you think this is necessary?

A. To nurse their pups. Pups have to grow a layer of blubber to protect from cold water. (They are warm blooded mammals.) Explain difference from cold blooded fish. (Body temperature not constant, but same as surrounding water. Do not need blubber for insulation.)

5. Extension of concepts:

Dolphins and Whales are warm blooded mammals that nurse their young too.

Q. How have they physically adapted so that they do not need to rear their young on the land?

A. Blubber (born with layer and grow rapidly). Swimming ability (able to swim at birth). Can nurse underwater (baby does not suck. Mother contracts muscle which quickly ejects milk into mouth). Breathing (blowhole).

Seal

Sea Lion

Transparency 1

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Transparency 2 **Marine Mammals in the Sea: Dolphin, Sea Lion and Seal**

May be used to illustrate discussions and activities concerning the physical difference, similarities and swimming method of three marine mammals: the dolphin, sea lion and seal.

Suggested Activities:

1. Physical Characteristics and Swimming Method Discussion:

Question students on *how* the various different adaptations of body parts contribute to living in a marine environment. May use transparency 2A of body outlines, drawing parts in to illustrate:

a. Locomotion in water:

Seal—sculls hind flippers back and forth, uses front flippers for steering.

Sea lion—uses front flippers in up and down "flying" motion, back flippers used for steering.

Dolphin—tail fluke used in up and down stroke (making it easier to come to the surface to breathe), side flippers used for steering, dorsal fin for stability (keeps from rolling).

b. Seeing and direction location:

Use both eyes and ears (ears used in dark or murky waters).

Sea lions have external ear flaps.

Seals and *dolphins* have ear holes (adds to streamling).

c. Breathing:

Seal and sea lion—use nostrils (closed underwater).

Dolphins—use blowhole (closed underwater) on top of head (does not have to lift head to breathe).

d. Feeling:

Seals and *sea lions*—through whiskers.

Dolphin—transmitted through skin.

e. Hand bones:

Seals, sea lions and *dolphins*—in front flippers (covered with skin to form solid flipper).

f. Foot bones:

Seals and *sea lions*—in back flippers.

Dolphins—NONE, tail has developed flukes for swimming.

2. Art Expression Activities:

Use as illustrations after visit to Sea World where students have had an opportunity to watch marine mammals move in water. Encourage students to *express* the *feeling* of graceful movement, the smooth, streamlined body, the agile, curving lines in motion, etc., *through* the *tactile media* of:

a. Clay modeling

b. Finger painting

Transparency 2 Dolphin, Sea Lion and Seal (cont.)

3. Language Expression Activity:

With help ot teacher, students might compile lists of adjectives that draw *word pictures* of their *impressions*: for example describing physical lines, movement and play behavior of:

Dolphins: Graceful, streamlined, fast, leaping, agile, etc.
Seals: Slow, smooth, sleek, round, watchful, etc.
Sea lions: Flexible, quick, playful, quarrelsome, etc.
Killer Whales: Big, strong, fast, splashy, etc.
Elephant seals: Big, slow, noisy, wiggly, etc.

4. Additional Activities:

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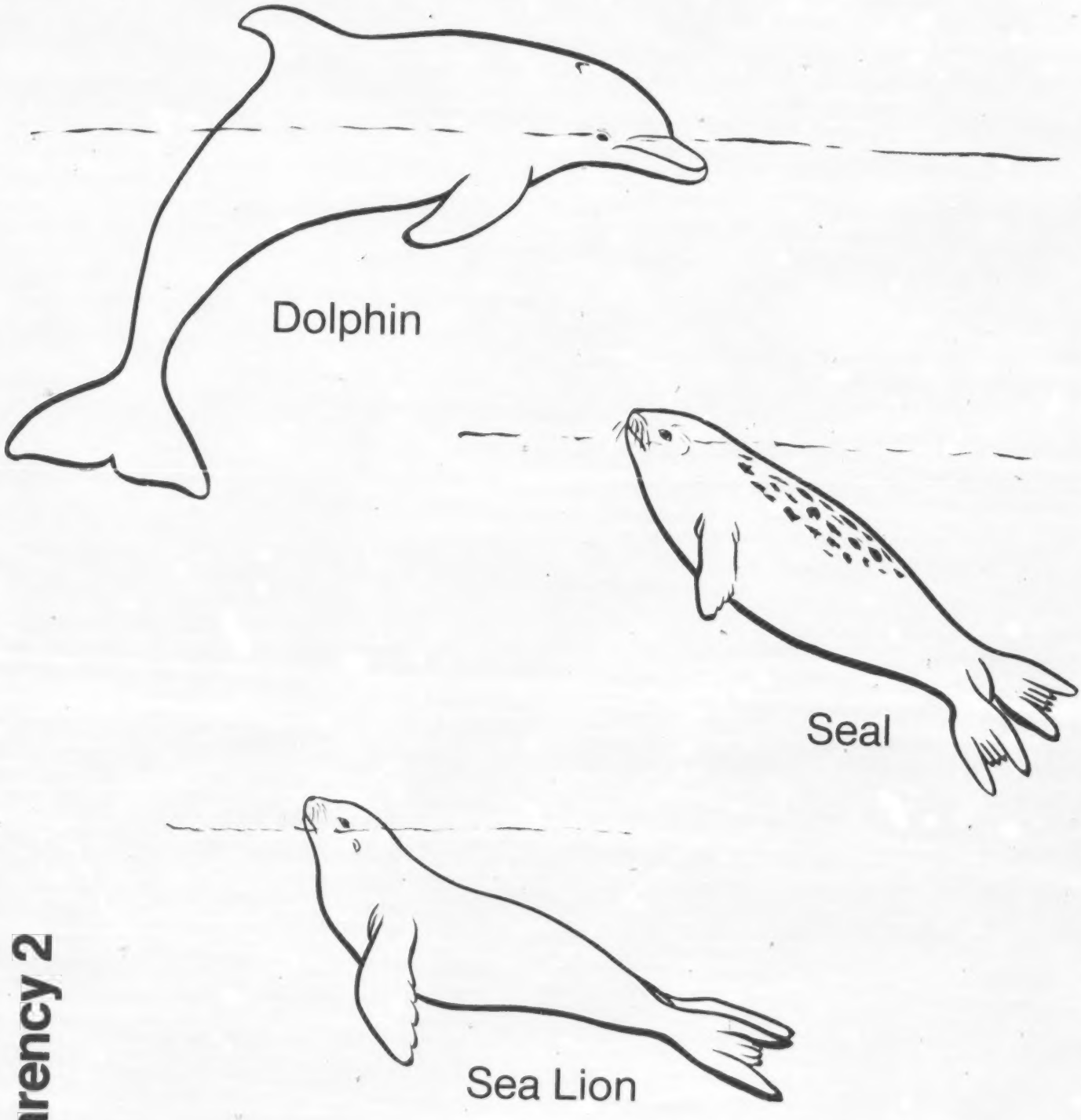

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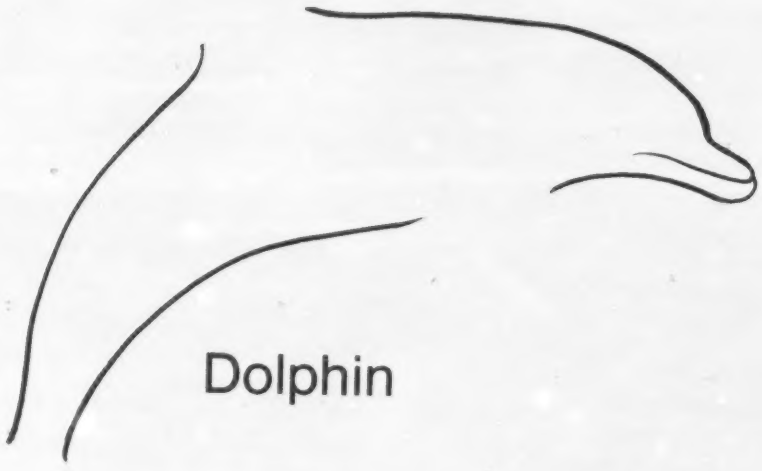
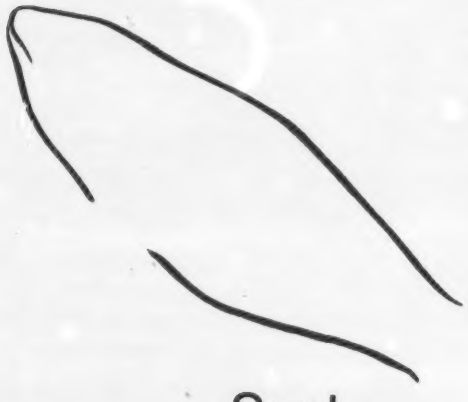


Dolphin



Seal

Sea Lion

Transparency 2A

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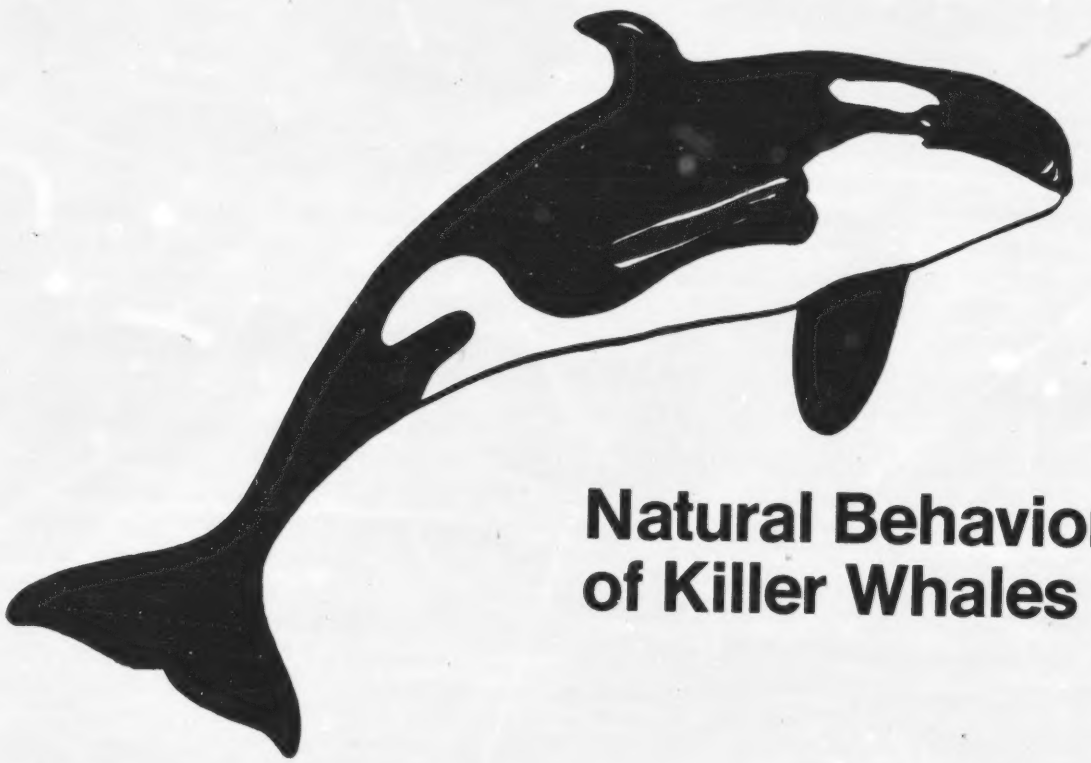

Natural Behavior of Killer Whales

The Killer Whale is a Delphinid, which means it belongs to the same family of marine mammals as the bottlenose dolphin.

Cruising the oceans of the world in search of fish and squid, as well as seals, sea lions and other marine mammals, the Killer Whale has no known enemies.

BORN IN THE SEA

Like dolphins, baby Killer Whales are born and nursed in the water for which they are perfectly adapted. The young whales develop their swimming skills by leaping, diving and tumbling about their parents and by chasing each other.

PRECISION SWIMMING

Pods of Killer Whales are often seen swimming and diving simultaneously through the sea, like ranks of soldiers. Unlike some other whales, which dive to great depths, they usually make a series of short shallow dives while swimming.

SOCIAL ANIMALS TRAVELING IN PODS

Killer Whales travel in family groups or pods of usually 3 to 4 members. For hunting, several family pods will join to form a single school. The cows and calves usually stay together, while the bulls swim together some distance away, making side excursions into coves and beaches to look for food.

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Killer Whale Behavior (cont.)

HUNT IN PACKS

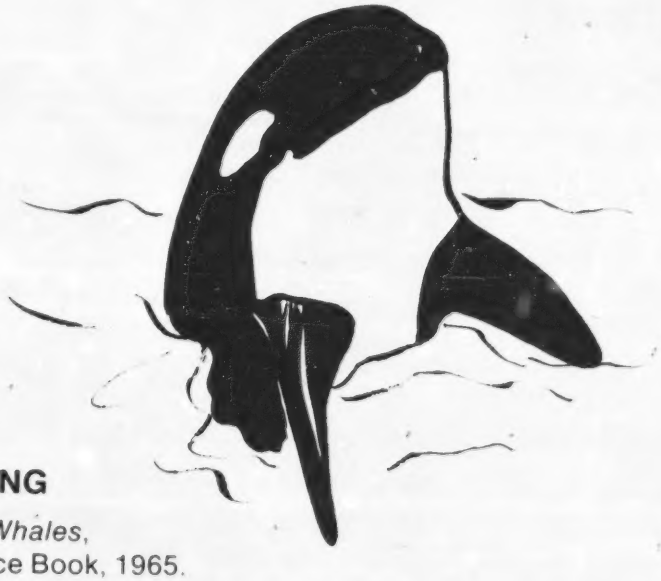
Using teamwork, the Killer Whales hunt in a pack to surround and herd their victims. A group of Killer Whales, swimming at high speeds, will rush toward a group of seals or sea lions sunbathing on the rocks or ice, frightening them so that they fall into the water.

In areas of sea ice, several whales will swim under a group of seals sunning on the ice. Then they crack and thrust the ice upward with their heads, sliding the seals into the water to the waiting Killer Whales.

SPY HOPPING, BREACHING AND LOB TAILING

To visually orient themselves, Killer Whales frequently raise vertically out of the water to look around, in a behavior called spy hopping. Another characteristic behavior, called breaching, is to leap out of the water and land with a great splash. It is thought that this might be a method of signaling to other whales in the pod, or perhaps they do this to knock loose annoying skin parasites. They are also seen floating on their backs, scratching their sides with their pectoral flippers.

Another behavior, in which they slap the water with their tail flukes, is called lob tailing. It is believed to be a method of signaling to others in the pod when food has been sighted.



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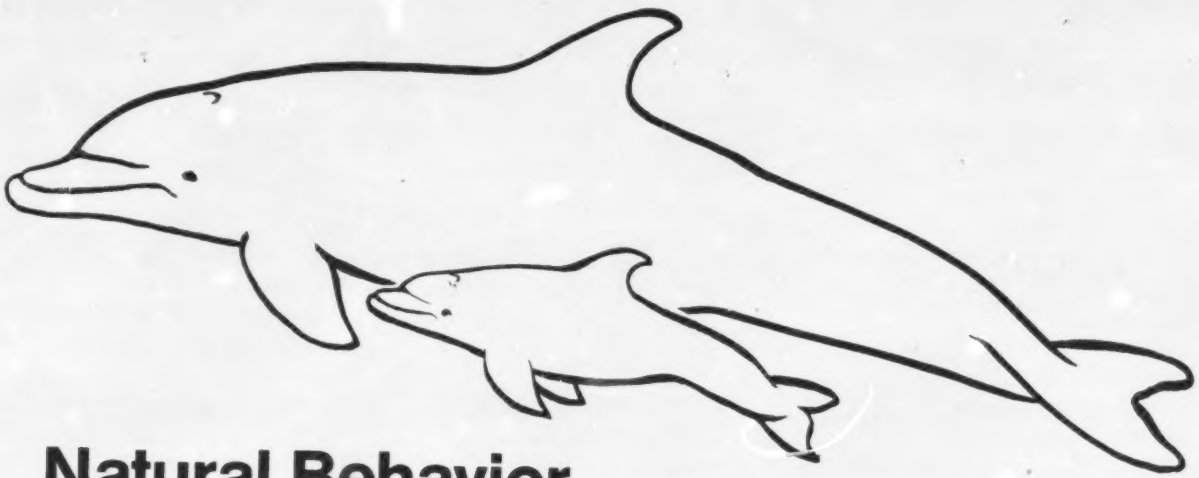

Natural Behavior of Bottlenose Dolphins

A dolphin is a strong, fast and agile swimming marine mammal. They are highly social and playful animals with a tendency to be very inquisitive.

MAKE A GAME OF LEARNING

Dolphins are born with the ability to swim, but young dolphins must practice and develop this ability in order to catch food and escape from danger. They learn by playing games.

A favorite game is to balance objects (bits of seaweed, stones, pieces of fish) on their snouts or flippers as bait to tease and invite other dolphins to chase them, and steal it if they can. Another favorite game is to push objects around with their snouts, such as stones, turtles and other animals.

They are quick to develop new games that will get others to play with them. There have been cases reported of wild dolphins even coming daily to play games with human children.

Highly coordinated swimming maneuvers are practiced through such play behavior as surfing, riding the bow waves of boats, and close order unison swimming and leaping games.

PLAY BEHAVIOR USED TO CATCH FOOD

Dolphins enjoy herding things, and use this behavior to catch fish. Swimming around, above and below the fish, they keep them together while the dolphins take turns feeding.

Along the coastal mudflats of eastern Florida and Georgia, dolphins have been seen mudsliding. Much like you would get a running start on a dry pavement to slide on a wet or icy strip, the dolphins get a fast swimming start in deep water to slide out on their bellies on the slippery mud. This same behavior is used to catch stranded fish on mud flats.

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Dolphin Behavior (cont.)

Dolphins will spend hours playing these games. At the same time, they are developing the muscles and swimming skills which will make it possible for them to catch food and survive in their marine world.

SOCIAL ANIMALS WHICH HELP EACH OTHER

Dolphins will group together in times of danger to protect each other. Usually the mothers and their young will stay close together, while the young males are sent out to scout.

Should one or more dolphins be caught in a fishing net, others will try to help it escape, and often end up getting trapped themselves. Fisherman have been trying to solve the problem of dolphins being caught in their nets, by using the recorded sounds of the Killer Whale (a natural enemy of the dolphin) to frighten them out of the nets.

HOLD WEAK AND INJURED AT SURFACE TO BREATHE

When a new dolphin is born, another female dolphin will stand by to help the mother. If the baby is too weak to swim to the surface on its own, they will hold the baby up with their snouts so that it can breathe.

If an adult dolphin is sick or injured, other dolphins will support it at the surface for hours, or even days, so that it will not drown. They will also use their bodies to keep a sick companion from bumping into things and injuring itself.

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Natural Behavior of Seals and Sea Lions

Sea lions and Seals are marine mammals called Pinnipeds or "fin-footed ones." Their home is the sea, but unlike the dolphins and whales, seals and sea lions are also at home on land.

PUPS BORN ON LAND

In the spring and early summer months, sea lions and seals return to the island or strip of coastline where they were born. Here they give birth to and raise their young pups. The large male bulls stand guard and protect the mothers and pups.

BLUBBER PROTECTS PUPS FROM COLD WATER

The young pups feed on their mother's milk (which is extremely rich in fats) and grow round and plump with a thick layer of blubber. This will keep them warm in the cold water. A young Elephant Seal may gain as much as 20 lbs. a day!

LEARN THROUGH INVESTIGATION AND PLAY

The young pups play together among the rocks of the shore, investigating with their whiskers and front flippers. The sea lion pups "gallop" about on both their front and back flippers, while the seal pups "hump" along like caterpillars. The young sea lions like to toss small objects like pebbles into the air and catch them in their mouths. Mock battles, with much weaving of necks, nipping and barking, are another favorite pastime.

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Seal and Sea Lion Behavior (cont.)

MUST LEARN TO SWIM AND DIVE

When the pups are several weeks old, the mothers will take them into the shallow water for swimming lessons, and they will teach them how to dive for fish, crab, lobsters and squid. The pups learn quickly and in a few months, when the time comes to leave the land and return to the sea, to find food for the Winter, they can swim and dive as well as their parents.

SEA LIONS LIKE TO PLAY

Agile and flexible swimmers, sea lions like to twist and turn quickly about, chasing each other through the kelp beds, turning somersaults over each other and chasing their own air bubbles. With their strong front flippers, they "fly" through the water "dolphin leaping" after each other and surfing on the waves.

SEALS ARE GRACEFUL SWIMMERS

Although slow and clumsy on land, since they are unable to use their hind flippers for walking, once in the water the seal is a graceful, streamlined swimmer. Using their hind flippers for propulsion, they can travel at surprisingly fast speeds when necessary. Calmer in manner than their sea lion cousins, seals spend much of their time sitting up in the water keeping an alert and watchful lookout on their surroundings.

EXPERT DIVERS

Seals and sea lions make long deep dives, often to 1,000 feet or deeper in search of food, and can stay underwater for 10 minutes or longer at a time. Elephant Seals often will lie on the bottom and wait for food.

HIGHLY SOCIAL ANIMALS

Elephant Seals and sea lions are very social animals. They like to group together on the beaches and rocks to sun themselves. Mixed groups of seals and sea lions are often seen together, with the California Sea Lions using the large soft Elephant Seals as mattresses.

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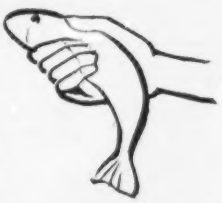
Sea World trains a "Star"

How does a trainer at Sea World teach a Killer Whale to allow him to put his head in its mouth? How do they train dolphins to perform high spinning leaps? Or train a sea lion to balance a ball on its nose?

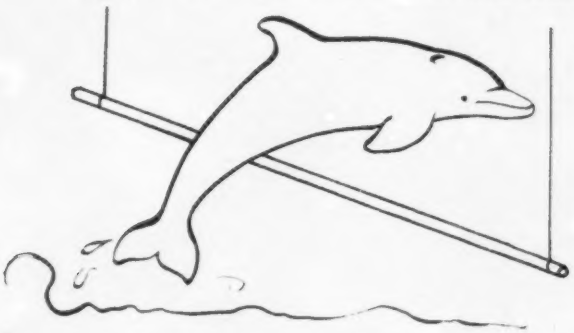
To train a dolphin to jump over a pole—

The trainer chooses a natural leaping behavior. Each time he sees a dolphin do a low graceful leap he immediatedly blows a whistle (bridging signal) to let the dolphin know that is the behavior he wants. Then he rewards it with a fish.



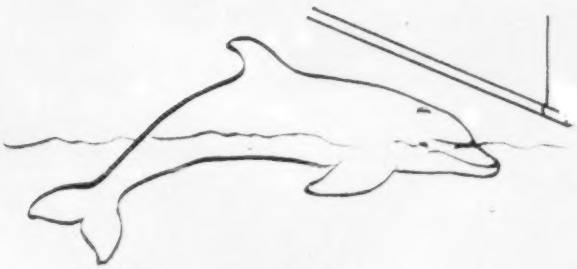
Through this training process, the dolphin soon learns to jump on signal to receive a fish reward. Now the dolphin can be trained to jump in a particular way.

A pole is suspended over the water—

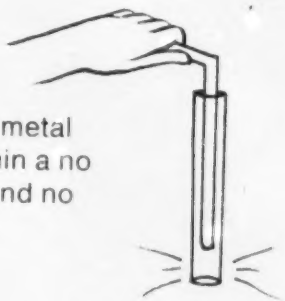


The dolphin is no longer rewarded for just jumping, but now must jump over the pole to hear the whistle (bridging signal) and receive a fish reward.

If the dolphin does not jump over the pole—



The trainer taps on a metal pipe to give the dolphin a no signal (delta signal) and no fish reward is given.



Slowly then, lesson by lesson, a highly difficult jump can be trained, by the trainer being more and more selective in rewarding the animal.

Like people, some dolphins learn more quickly than others. Therefore, the length of time needed to train them, may vary from a week to several months. Also, the more difficult the behavior, the longer it takes to train.

What have you learned about Animal Training?

To discuss with your teacher:

How does the trainer get a dolphin to slide out of the water?

To "stand" on its tail?

If you were a trainer at Sea World, how would you train a sea lion to walk over and touch your hand?

What would you use for a bridging signal?

_____

What would you give the sea lion when he touches your hand?

_____

What would you do if it did not touch your hand?

_____

Applying what you have learned about Animal Training:

How would you train a dog to come to you?

What might you use for a bridging signal? (List several different kinds you might be able to use.)

_____

What could you give him as a reward? (List several possibilities.)

_____

Can you describe how you would teach your dog to pick up a ball, bring it to you, set it at your feet and then sit down?

Remember, each action must be trained seperately, step by step, until the whole behavior is learned.

Remember too, that trainers must have a lot of patience, and that trainers at Sea World never use physical punishment. The animals are trained with rewards.

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